TEXTILE RESEARCH

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Outstanding Features in

This Month's Issue

Research and the Patent System

In any correction of the existing faults in a system the ultimate interest of the many must not be jeopardized by the faults of the few and by expedient doses administered in general to correct the few. This article discusses some of the popular misconceptions in regard to the use of patents and cites the viewpoints held by some corporations toward patents. (See page 2.)

Effects of Water Temperature in Evaluating the Efficiency of Water-Repellent Finishes

The importance of water temperature in evaluating the efficiency of a fabric treated with a water-repellent cannot be overemphasized and specifications should state specifically such control of test methods. Because of the wide variation in results due to temperature, the present investigation was undertaken to establish the relationship existing in well-known hydrostatic pressure tests. (See page 11.)

Infra-Red Drying of Textiles

Of interest to textile men will be the data obtained from tests conducted on the evaporation of water from textile fabrics by means of gas generators. The lack of specific data upon the subject led the author to perform tests on a commercial gas-fired infra-red ray generating unit to obtain some data on the relative efficiencies of drying when subjected to certain variables usually encountered in industrial applications. (See page 18.)

Popular Misconceptions in Regard to Use of Patents Are Discussed in

Research and the Patent System

Part II.—Patents and the Corporation

By H. WICKLIFFE ROSE*

To stimulate research and development was the primary purpose for which the patent law was enacted. That there have been abuses of the system is admitted, but as a prelude to intelligent correction of existing faults there should be more widespread knowledge of the facts as revealed by actual practice.

In this series of articles by Mr. Rose, Part I.[1] *dealt with the system in its relationship with the individual inventor. Part II., which is presented herewith, discusses the experience of corporations in the use of patents. Although the cases cited are taken from the rayon industry an analogy may be drawn which will apply to other branches of the textile industry. Part III., which concludes "Research and the Patent System," will discuss the commercialization of patents and will appear in the September issue of* TEXTILE RESEARCH.

THE SCRUTINY OF THE PATENT SYSTEM referred to in the previous article has brought attention to the ills and faults fancied or factual, the malevolence and malpractices of the few, and the headaches and heartaches of the many in a system which, after all, must be run by humans. The ultimate interest of the many must not be jeopardized, however, by the faults of the few and by expedient doses administered in general to correct the

* H. Wickliffe Rose, coordinator of research planning, American Viscose Corporation, Wilmington, Del.

[1] Research and the Patent System, Part I.—The Individual Inventor, Textile Research, July 1943.

few. The greatest mistake made by the Axis is to ignore the ethical in man, and it will be as tragic a mistake in this country if any basic changes are made on the assumption that the American citizen is not essentially, and in the vast majority, ethical. Even where it may not have been inherent, it has long since been found to be good business.

Research is used by a corporation broadly with sixteen objectives:

1, Improve production technique; 2, lower production costs; 3, modify products; 4, improve products; 5, create new products; 6, conserve materials; 7, provide raw materials and supplies; 8, create employment; 9, inform employees; 10, improve working conditions; 11, improve environs of plants; 12, assist customers; 13, assist consumers; 14, widen markets; 15, develop specific information; 16, advance the general field of knowledge.

The rayon industry, after thirty-two years of production and development, has reached a level of basic technique, but it has by no means exhausted all the possibilities, and that level is not a ceiling. In every one of the sixteen subjects listed above work is actually being done in the industry, and patents are being issued every week covering inventions or improvements in these subjects. In general the commercializing of the useful patents has been accomplished, not only by the inventor putting them to work but by his offering them on a liberal basis, which has permitted their use by others. There is no patent pool in the industry, but it has been found that liberality in terms enables competitors to use the same invention while the owner of the patents enjoys a modest return.

Liberal Terms to Competitors

For example, the double godet patent for improving the strength of viscose rayon and the titanium oxide patent for dulling any type of rayon are used quite generally in the industry. When the double godet patent was issued and the strength of rayon was improved materially thereby, it was offered on very liberal terms to the other producers. In fact, one producer paid more than the price asked after arbitrarily placing a higher value on it, probably because he felt indebted at the lower fig-

ure. The policy of liberal terms was not prompted by naive altruism, but by recognition of the possibility that the production of inferior rayon by competitors could do more to hurt the use of rayon in public favor, and so to hurt the owner of the patent, than any possible difference in financial returns would be worth.

The relative position of the corporation in an industry, and the degree of consumer acceptance of the product, both influence the policy in appraising a patent and commercializing it. The plurality producer in an industry as subject to style and fashion as rayon necessarily feels a greater responsibility for the product and the public interest than the smaller producer. Furthermore, he has more at stake. He knows that a successful patent not offered invites attack either legal or technical, and that a patent not enjoyed by competition may be either broken or beaten. Where the patent is basic the risk can be taken, but where it is only an item or process in a larger technology the risk must be carefully weighed.

The Singmaster case for dulling rayon with titanium oxide, while it followed a complicated course to commercialization, was not as disheartening to the licensor as many prove to be. It was developed in and by a rayon company. It was offered and accepted by other companies, but it was opposed by one. The case was of interest because it hinged both on ownership and validity of the patent. The decision of the court found the patent valid and that ownership rested with the company in whose employ the invention was made. The rayon company, which had developed the invention, then purchased the rights, the opposing rayon company took a license, and the industry thereafter enjoyed the use of the process at a price which was not a burden. The public paid the cost of the development and of the necessary machinery and equipment to practice the invention, and then the premium was removed from the price of the yarn. Meanwhile, the premium had amounted to about a cent and a half in the cost of a lady's dress, and the invention enhanced immensely the beauty and style of rayon clothing.

Other major developments are taking place in the

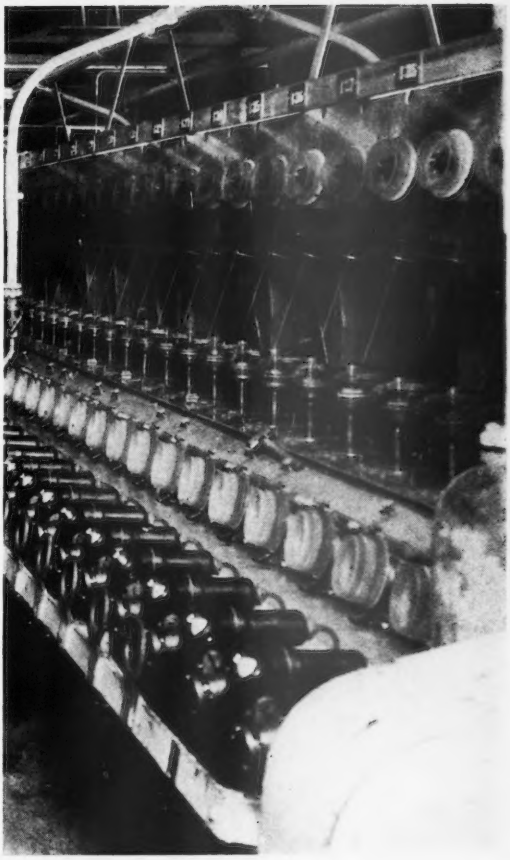


Fig. 1. Viscose rayon spinning machinery showing the upper and lower godet wheels used in the double godet method of spinning.

rayon technology, particularly under pressure of the war program and because of the necessity of inventing to conserve manpower. Methods of washing the cakes of rayon yarn have been developed and installed. They not only make it unnecessary to wind and handle skeins through the finishing process, but the spinning cake is being shipped and wound from that form in some textile processes. Part of the saving gained is passed on.

Another process, going one step farther, is established in at least one rayon company. In this process the yarn is spun, treated, dried and packaged in continuous operation. (Illustrated in TEXTILE RESEARCH, p. 15, July, '43.)

In the rayon industry it will be found, however, in spite of theories to the contrary that the technological changes which supplant jobs, compensate in the aggregate by broadening the consumer acceptance of the product, expanding production, and affording other employment within the industry. The new developments which are

taking place now, if properly commercialized after the war, will undoubtedly mean an increase in production and employment, thereby assisting in the major problem of absorbing the manpower released by the war and of readjusting industry to peacetime pursuits.

The Corporation vs. Patents

Before coming to the commercialization of patents we should examine the points of view which different corporations have toward patents. Not every industrial corporation is patent minded. In fact, some are indifferent, some are passive, and others are actively hostile to patents.

Most opposition is to the exploitation rather than the employment of patents. There is natural resentment against exploitation of anything, whether it be the soil, the labor of man or beast, or of goods and rights. There is natural resentment against those who exact payment for something which has not been earned, and no part of which payment contributes to the improvement of the art. Such royalties are looked upon as private toll on a road in the building of which the collector has taken no part, and the improvement of which he will completely ignore. The term "royalty" is in itself obnoxious to some as being reminiscent of the arbitrary exercise of the royal prerogative. In short, the exploitation of patents is looked upon by some corporations as a nuisance, and by others as a racket.

The person, or corporation, who patents for exploitation does harm to the public interest and to the patent system. The acquisitive instinct finds an outlet in patents, as in stamps, money, or antique furniture. Once a patent case has been divided, like the cells in an organism, there is an urge to multiply, and once a patent estate has begun to take shape, the thrill that goes with collection and possession can make both a vocation and an avocation of it.

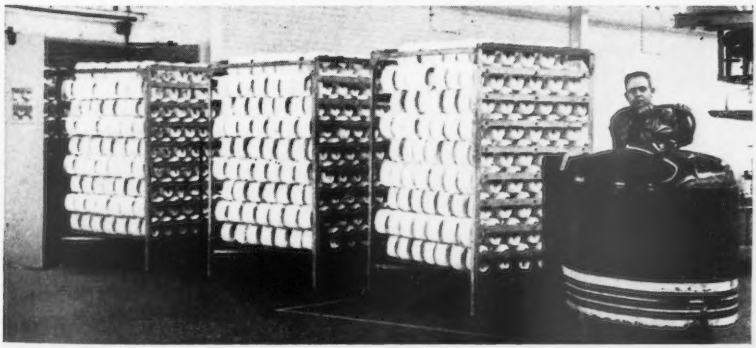
Thus the Patent Office becomes overburdened with work and records, and technology becomes cluttered with nuisances. Fortunately the corporation which runs a patent mill usually defeats any purpose it may have of either exploiting or employing patents. The sheer volume of patents and the rapidity with which they issue

make it impossible for employment or commercialization ever to catch up.

A barrage of patents thrown around a subject to establish a monopoly can also defeat its own purpose. As in the famous Dreyfus case, in which the weight of evidence was so great that its validity was suspected for that reason, a subject too well covered by claims can be exposed by inviting attack through their very number, and the penetration of claims which have covered too much ground can endanger the entire position.

There is some objection to patents because of the thought that they are taken out with no intention of employment or exploitation but of suppression. This objection is only mentioned here because it is known to exist. It has long been my opinion that few if any patents are acquired for suppression. I have frequently inquired and have yet to have an instance named. The prevalent misconception on this subject probably arises from the fact that in the course of a development a number of methods of doing the same thing may occur and each is patented without any idea of which will be the best in commercial practice. The fact that those not employed, for perfectly good practical reasons, remain as a protective hedge around the one selected does not offset the impression that the inactive patents have been placed on the shelf deliberately and so are suppressed. Patents purchased and then not used are under suspicion of suppression, but a large percentage of patents acquired by purchase or development are not brought into practice

Fig. 2. Train of rayon cakes after being washed, on the way from the cake wash to the drying department.



for the simple reason that better means are discovered later, or that they are found to be technically or financially impractical, or that the demand has shifted to something else.

Some corporations are not patent minded because they fear the deterring influence that patents can have on the research worker. This objection can be overcome readily by proper direction of research work, but it is mentioned because it is real. A research worker engrossed in the patent art on a subject can be diverted from original thought. The original thought can best come first, and then there is ample time to look up and see who has had it before.

Others oppose patents because they prefer secrecy. In all the reviewing and reforming of the patent system taking place currently, there has been little made of this solitary alternative to the patent system. It is patent that the word patent means apparent, open for all to see. The alternative is to keep the subject a mystery. In the days of the guilds the art or craft was known as the mystery, and one entered into apprenticeship to acquire the mystery. Today apprenticeship is practically a thing of the past, and trade secrets are mysteries only within one's own corporation. The corporation which in general tries to operate in secrecy must isolate itself so thoroughly from its own industry that the result is more likely obsolescence than leadership. The management which plays its cards too close to its chest probably is too nearsighted to see those face up on the table.

Another reason that some corporations are not patent minded is because of the expense, particularly where litigation might be required. Cases in which no one has profited but the attorneys have kept many corporations from acquiring either patents or licenses. Fees are not the only costs to litigants in a patent suit where infringement and back royalties are at stake. If in the reforms now under discussion provision is made for quick determination of validity and infringement, a considerable risk will be removed, and the patent system will be employed and enjoyed more widely in the advancement of the arts.

RESEARCH ACTIVITIES

American Viscose Corporation announces that the name of its Sales Development Department at Marcus Hook, Pa., has been changed to Textile Research Department. The change has been made in order to clarify the purposes and character of the department's activities, particularly during the war period.

Colonel Robert C. Brady, formerly Commanding Officer, Philadelphia Quartermaster Depot, has been named Commanding Officer for Fort Worth Depot, Fort Worth, Texas.

The fee for obtaining a license to use enemy owned patents held by the Alien Property Custodian has been changed to a flat $15 for each patent. Information concerning the 40,000 patents and patent applications now held by the Alien Property Custodian can be obtained by addressing the Office of Alien Property Custodian, Field Building, Chicago, Ill.

Dr. Clifford B. Purves, of the Massachusetts Institute of Technology, has been appointed E. B. Eddy professor of industrial and cellulose chemistry at McGill University. Dr. Purves succeeds Prof. Harold Hibbert whose retirement becomes effective the end of August.

The Chemical Foundation, Inc., reports the development of a new method of treating cotton fabrics that enables them to retain their tensile strength after bleaching with sodium hypochlorite, and gives them a higher resistance to cellulose-decomposing bacteria. The process is being made available to American manufacturers under a licensing arrangement. This process was developed under the direc-

tion of Wanda K. Farr, who was formerly associated with the Foundation.

Colonel Roland Walsh is now Commanding Officer at Philadelphia Quartermaster Depot. This is the third term of duty for Colonel Walsh at Philadelphia. The first was June 1919 to May 1922 and the second May 1933 to June 1939.

The first class of girls to complete the 12 week training course for laboratory technicians at Philadelphia Textile Institute was graduated in July and immediately reported for duty at the Philadelphia Quartermaster Depot. This course was designed by the Institute in co-operation with the Philadelphia Quartermaster Depot for the purpose of furnishing qualified personnel for work in the textile testing laboratories at the Depot.

Richard L. Cox has been made dean of the Philadelphia Textile Institute following the resignation of M. Earl Heard. Mr. Cox has been assistant dean for many years.

A new textile research laboratory is planned by the Monsanto Chemical Co. The scope of the new laboratory research will include detergents, wetting agents, finishing processes, fireproofing, waterproofing, and mildewproofing.

Roland L. Lee has left the Southern Regional Research Laboratory at New Orleans to join the staff of Callaway Institute, Inc., La Grange, Ga., as cotton technologist and dean of the Institute's educational activities. Previously he had been engaged in cotton testing work for the Department of Agriculture, and as an instructor in the textile school at Clemson.

Tests Show Effects of Water Temperature in Evaluating the Efficiency of

Water-Repellent Finishes

By H. G. WALZ* AND K. R. FOX*

CHEMICAL TREATMENTS to render textile fabrics more or less water-repellent have been under investigation for many hundreds of years. Until about a generation ago such treatments were used almost exclusively on materials such as raincoats, tarpaulins, ducks, and the like, but today water-repellent finishes are used in many diverse civilian outlets, such as, ski jackets, golfing and hunting clothes, reversible topcoats, children's playsuits, and many other such uses. With the advent of the present hostilities, the Quartermaster Corps, for example, has specified water-repellent finishes on such materials as jackets, trench coats, ski troop parkas, parachute troop uniforms, overcoat linings, and many other military requirements. It was estimated about a year ago that at least twenty million yards of cotton fabrics were treated each month with water-repellent finishes for civilian and Government use.

The evaluation of water-repellent textile finishes has presented a serious problem. As long ago as one hundred years, methods for evaluating the efficiency of the treatments have been given serious consideration. As described by Stenzinger (1),[1] Carl C. Schmieder in a book of that period titled "The Waterproofing of Fabrics and Some Other Materials" discussed the relative advantages and disadvantages of several test methods. Since that time, due largely to joint committees representing the American Association of Textile Chemists and Color-

* Textile Division, M. I. T.

[1] Figures in parentheses represent literature references at the end of this paper.

ists and the American Society for Testing Materials, many new tests in addition have been evolved but basically all of them follow the three main classifications: 1, Hydrostatic pressure tests (2, 3); 2, Surface wetting and penetration tests under falling water (4, 5); 3, Absorption tests in water (6).

A more complete discussion of these different tests can be found in a Textile Research Supplement (7) or in a paper by Scott (8).

The importance of water temperature in evaluating the efficiency of a fabric treated with a water-repellent cannot be overemphasized and specifications should state specifically such control of the test methods. Stiegler and Hood (9) have shown that water temperature in the conventional spray chest (10) very seriously affects the test values and may under critical conditions be responsible for the acceptance or rejection of a lot of material. Variations as large as 100 percent in ratings may result from tap water variations expected in the ordinary laboratory. Because of this wide variation in results due to temperature, the present investigation was undertaken to establish the relationship existing in the well-known hydrostatic pressure tests.

Method of Test

The apparatus used for the investigation is shown diagrammatically in Fig. 1. It will be recognized that the arrangement is quite similar to the conventional A.A.T.C.C. or A.S.T.M. equipment except that a thermometer has been inserted just over the surface of the test specimen in order to record the water temperature in close proximity to the fabric. In addition, the clamp holding the fabric was redesigned using an air vent in order to prevent any trapping of air between the water and the fabric.

After the sample had been inserted in the apparatus, water at different temperatures was diverted by means of suitable valves to run into the vertical tube and hence to the top side of the fabric. The head of water was allowed to build up at the rate of one centimeter per second until three distinct spots indicating leakage appeared. At this time, the head of water necessary for the leakage

was noted on the scale and the corresponding temperature recorded. Any drops of water or zones of leakage occurring at the circle of contact between the fabric and its clamp were discarded as false readings. This was done to avoid errors due to injury of the fabric by the method of clamping. A temperature range of from about 15° C. to 45° C. was investigated.

There are many types of water-repellent compounds that have been commercialized. The bulk of these can be identified in any one of the four following broad subdivisions: 1, fatty and resinous insoluble substances; 2, metallic soaps and some organic salts; 3, synthetic resins or similar products; 4, chemically modified fibers. Many modifications of these general classes can be made, and the effectiveness of any one compound is dependent to a large extent on the method of application with respect to the construction of the fabric, as well as the characteristics of the compound itself.

Among the many fabrics investigated, samples of both the resin type and wax-aluminum salt type were tested. As the swatches provided by the different manufacturers for this work varied in construction as well as type and concentration of the repellent, the ac-

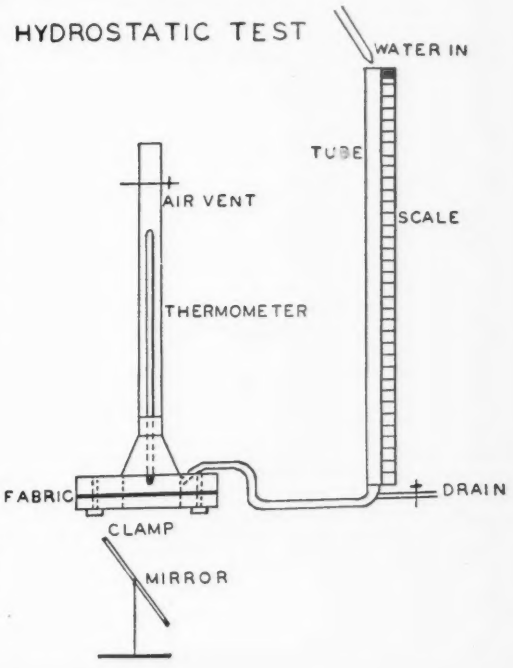


Fig. 1. Apparatus used for investigation of effect of water temperature in evaluation of efficiency of water-repellent textile finishes.

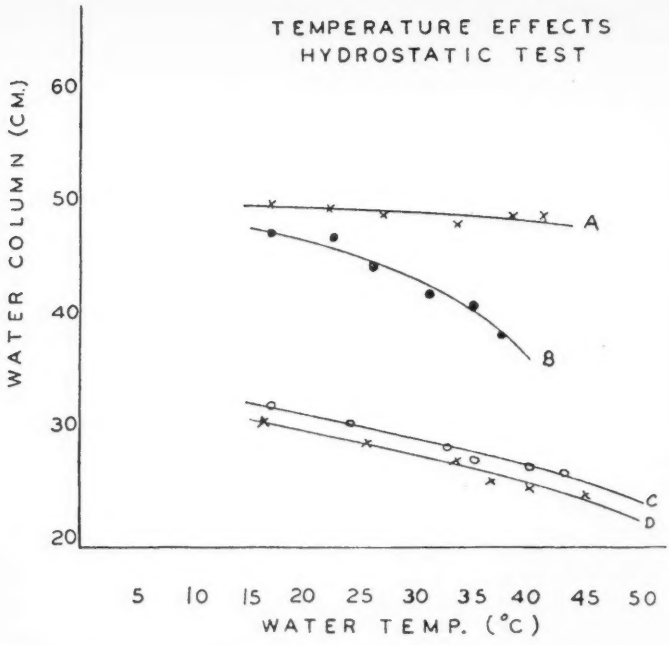


Fig. 2. Results of hydrostatic tests on fabrics treated with water-repellent finishes: A.—OD cotton poplin with permanent resin type finish. B.—OD cotton poplin with wax-aluminum type finish. C. and D.—8-oz. cotton fabric with wax type finish.

tual test values were not quantitively comparable. However, for any one given fabric and treatment, the temperature effect trend is significant and in general applies to all fabrics treated in a similar manner. The effect of varying the concentration on a given construction was also investigated to a limited extent.

Results

Fig. 2 indicates graphically some of the test results. Curve A for the permanent or resin type applied to an OD cotton poplin shows very little decrease in hydrostatic pressure with temperature. This slight decrease agrees with the spray test findings of Stiegler and Hood (9). The overall change can be made more severe by increasing the temperature range, but it was felt the tempera-

tures selected more nearly approximate the variations that might be expected in normal testing procedures.

Contrasted with these data, Curve B for one of the wax-aluminum salt type finishes as applied to a poplin shows a change in pressure rating that is quite pronounced, being somewhere in the vicinity of 25 percent. This difference in values could very easily represent the difference between acceptance or rejection of a lot. Satisfactory material might be refused and, perhaps worse, a material definitely below the specification value could be made to pass as suitable material by unscrupulous choice of the water temperature.

Curves C and D represent the results of tests on a heavier cotton fabric of 8.2 ounces per square yard. The compound was also of the wax type using a concentration of 3 percent in the case of sample C, and 1 percent in the case of sample D. As in the case of sample B, the loss in water-repellent qualities with an increase in temperature is quite marked.

The degree of waterproofing by any compound is dependent also upon many other factors, such as cloth construction, yarn size and twist, but it seems very advisable adequately to emphasize specifications for testing which incorporate methods for controlling the water temperature in order to put such tests on a sound and reproduceable basis.

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RESEARCH AIDS

Practical Emulsions*

BECAUSE OF CERTAIN desirable properties, emulsions are used in various fields. The author of "Practical Emulsions" is the technical director of one of the leading and oldest manufacturers of emulsifying agents and emulsions. This book is intended to supply the lack of an authoritative treatise on how to make, use and evaluate emulsions for industrial use or resale.

Numerous specific examples are included, in sufficient detail, so that a beginner in this field can quickly learn the "how, when and where" of emulsions. The correlation of known information and inclusion of hitherto unpublished matter will be useful, even to the specialist. Detailed listing of emulsifying agents, and emulsions is given. Included also are many formulas for emulsions used in the textile industry.

* PRACTICAL EMULSIONS. H. Bennett, *Chemical Publishing Co., Inc., 24 Court St., Brooklyn, N. Y. 402 pp. Price $5.00.*

Thermal Transmission Tester

WARMTH OF FABRICS is determined at the National Bureau of Standards by measuring the thermal transmission by means of the apparatus illustrated by the accompanying schematic drawing (Fig. 1).

It consists essentially of a square metal plate, in a horizontal position, provided with heating elements and thermostats for heating it to a predetermined temperature, approximately 113° F., and maintaining it at this temperature. Loss of heat from the plate in all directions except upward through the specimen is prevented by guard elements heated to the same temperature as the plate. A metal hood is provided to eliminate the influence of air currents. The plate and the inside and outside of this hood are painted with carbon black lacquer to produce a surface having an emissivity between 0.95 and

1.00. Means are provided for determining the amount of heat supplied to the plate, the temperature of the top of the hood, the temperature difference between the plate and the top of the hood, and the temperature difference between the plate and the guard elements. The amount of heat supplied to the plate per unit of time divided by the difference in temperature between the plate and the hood and by the area of the plate is taken as the thermal transmission of the blanket in still air.

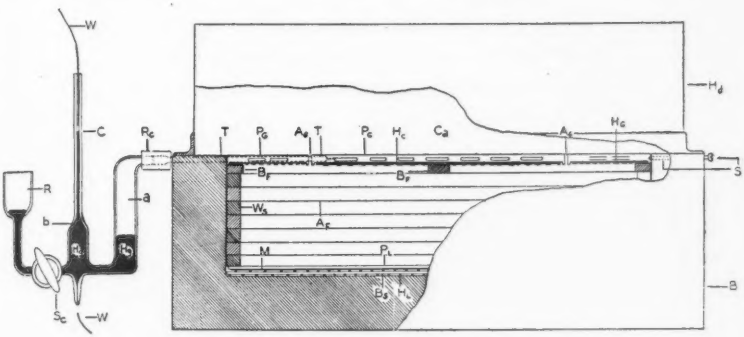


Fig. 1. Schematic drawing of thermal transmission apparatus for measuring thermal conductivity of textiles used by National Bureau of Standards.

a, bulb for mercury and methyl alcohol
a_f, aluminum foil
a_g, air gap
b, bulb for mercury
B, wooden box
B_f, Bakelite supporting frame
B_s, Bakelite sheet on which heating coil is wound
C, capillary tube
C_a, cavity filled with methyl alcohol
H_c, central heating coil
H_d, hood
H_g, guard-ring heating coil
H_l, lower heating coil
M, mica insulation
P_c, central copper hot plate
P_g, guard-ring copper hot plate
P_l, lower copper plate
R, reservoir for mercury
R_c, rubber sleeve
S, screws holding plates in position
S_c, stopcock
T, bronze tube connecting center plate to glass U-tube
W, wire in coil circuit of relay
W, wood spacers

Tests with Gas-Generated Radiation Yield New Information in Regard to

Infra-Red Drying of Textiles

By STEFAN L. GRAPNEL, F.T.I.*

Results of an investigation of infra-red drying of textiles are embodied in a thesis presented by the author in partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering at the Polytechnic Institute of Brooklyn. The author of the thesis concludes that the present infra-red ray gas generators depend for their drying properties mostly on convected heat. However, these generators provide a compact and useful method of drying, which has definite merit when judiciously applied. Test results, including an abstract of methods and description of apparatus employed, are given below. The critical review of literature and bibliography of the subject are contained in a separate mimeographed report [1] being issued currently to members of Textile Research Institute, Inc.

THE MAJORITY OF COMMERCIAL HEAT SOURCES deliver an appreciable portion of their energy in the infra-red spectrum, but most heating processes rely predominantly on heat transfer by convection. With the intermediate heating of the air between the source and the delivery point, two or more energy transfers result with consequent loss in speed of transfer and efficiency. From this point of view, infra-red heating, that is heating by means such that more energy is emitted as electromagnetic waves, is of obvious interest and presents attractive possibilities.

* Master of Technical Science of the Victoria University of Manchester, Eng. Research engineer—Belding Heminway Corticelli, Putnam, Conn.

[1] Infra-Red Drying—A Literature Survey. Non-members of the Institute may obtain copies of this report at a price of 50 cents per copy. Address: Textile Research Institute, Inc., 10 East 40th St., New York 16, N. Y.

It has to be borne in mind, however, that probably no practical apparatus can be devised where only one method of heat transfer is acting. Nevertheless, the object may be to concentrate on one type of transfer with the others as a secondary rather than an intended result.

There are two commercially available methods for radiant heat generation: by means of specially designed electric lamps or by incandescent refractory surfaces heated by gas. The generation of radiant heat by means of electric lamps with either tungsten or carbon filaments comprises by far the most accepted method. The reasons for this are probably in the ease of installation, low initial cost, cleanliness, and lack of fire hazard. The lamps are basically the same as lighting lamps but with filament temperature slightly reduced (to 2,500° K).

Application of gas-fired radiant heat generators has not received as much attention as have electric lamps.

The author of this thesis wished to utilize his previous training and experience in the field of textile engineering and approached the American Society of Mechanical Engineers, Textile Division, with this object in view. It was suggested that the subject of infra-red drying merited serious attention as a thesis topic and as a foundation for eventual future research. It was pointed out that the subject was quite new to the textile industry and was being promoted among many varying and conflicting claims. From this standpoint it was deemed worth while to accumulate and digest the available data and to perform some unbiased tests which would indicate the limitations and possibilities of the equipment available on the market. The author was interested primarily in evaporation of water from textile fabrics by gas generators, and he is obliged to report that no specific data on this subject have been encountered.

It is apparent that the work required in order to make a comprehensive contribution to the subject was far beyond the possibilities of a thesis, and also too much to demand of an individual unsupported financially. As a result it was decided to perform a limited number of tests on gas-fired commercial equipment and to obtain some data on the relative efficiencies of drying when subjected

to certain variables usually encountered in the industrial applications.

Objects of the Test and List of Variables Introduced

The following were the test objects:

1. To determine the validity of the theoretical drying equation (see equation (1)).
2. To determine the influence of cloth weight (which is a function of weave density and thickness) on the effectiveness of drying.
3. To determine the effect of the distance from the burner to the cloth on drying.
4. To determine the effect of cloth color on drying.
5. To investigate the influence of the material, from which the fabric was made, on drying.

In order to be able to provide a method of measurement of the effectiveness of drying, it was decided to judge it by the relative efficiency of drying.

The variables introduced during the tests were: 1, time of passage, i.e. time of exposure to the burner heat; 2, testing of three different weights of cotton fabric; 3, testing of three colors (white, red, and black) in each weight; 4, varying the distance of the fabric from 6 inches from the hottest burner zone to 4 inches; 5, testing of jute, heavy khaki cotton ducking, and worsted fabric, all of approximately the same unit weight; 6, passing some of the samples in either direction to determine whether this had any influence; 7, drying some of the samples on both sides in successive passages.

The Drying Equation

In deriving a basic differential equation for air drying of solids under constant drying conditions the writer followed the general pattern laid out by Walker, Lewis and McAdams,[2] with a slight alteration to apply to drying from one side only. This treatment is valid for a substance not subject to shrinkage, which applies in the tests to follow, since the fabric had been restrained.

The drying equation, designated as equation (1):

[2] Walker, W. H.; Lewis, W. K.; and McAdams, W. H. Principles of Chemical Engineering, p. 649, McGraw-Hill Co. (1927).

$$lN \frac{To - E}{T - E} = K\theta \qquad (1)$$

where,

To = Weight before drying
E = Dry weight
T = Weight after drying
K = Constant
θ = Drying time
lN = Logarithm to the base e

Equation (1) indicates that the drying time for various runs under the same constant drying conditions is directly proportional to the natural logarithm of the ratio of the initial and final free moisture and directly proportional to the thickness.

In drying substances with a high surface moisture, evaporation proceeds at a constant rate until the critical point A (see Fig. 1) is reached. After this the rate of drying decreases with the average free moisture content as called for by equation (1), the rate becoming zero at point C which corresponds to the percentage of equilibrium moisture.

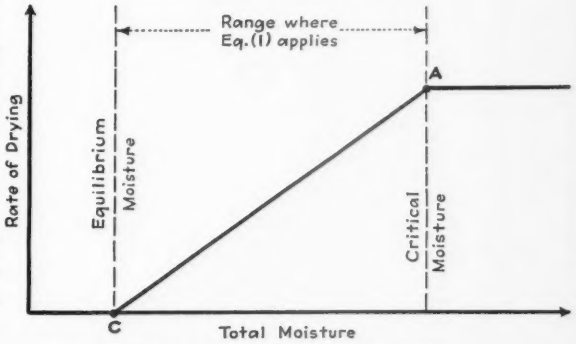


Fig. 1. Illustrates drying theory.

Test Equipment and Test Procedure

The test equipment was designed around a standard 24 inch infra-red ray gas generator supplied by the Carbomatic Corporation. In order to provide some means of passing the test cloths over the burner, a structure composed of a supporting frame and a movable slide was constructed as pictured in Fig. 2. The overall dimensions of the slide were 36 inches by 12 inches.

The burner was adjusted to give maximum radiant surface without the flame "licking-up," that is extending over the burner. During the tests this rate of gas consumption was maintained approximately constant and

slight variations were taken care of in the calculation of relative efficiency. The burner was left on during each series of runs.

All the cloth samples were weighed and measured in the dry condition. This condition corresponds actually to the equilibrium moisture content at room temperature and pressure. Subsequently the sample under test was wetted, wrung so that no water dripped from it, and weighed. The sample was placed on the slide pins and passed over the burner at a uniform speed. The time of passage was taken by means of a stop watch. The points at which the readings were to be taken were determined by passing a thermometer on the slide until it showed about 200 degrees F. These points on both sides of the burner were marked with chalk and are visible on Fig. 2. After the test run the sample was removed from the slide, and weighed again. In this manner the weight of water evaporated could be determined. The initial temperature of the water in the fabric was approximately known. Assuming that the latent heat of evaporation was supplied at 212 degrees F. and knowing the rate of gas consumption and its heating value as well as the time the sample was exposed to the heat, the relative thermal efficiency could be determined, as shown in Table I.

Fig. 2. Movable slide used in tests on infra-red drying.

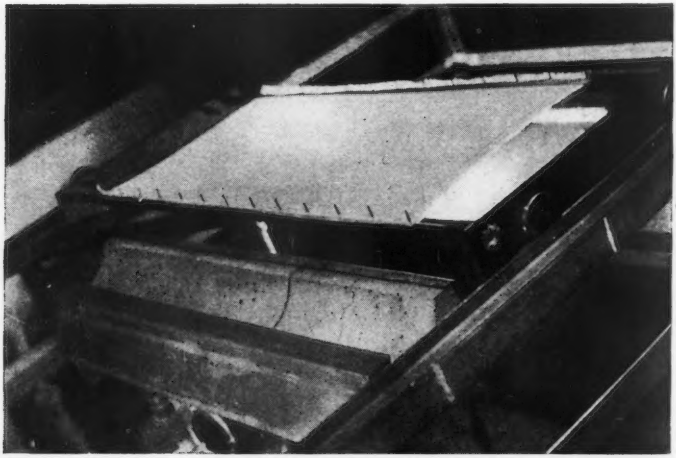


TABLE I. Determination of efficiency of drying.

Test series I. run 1. specimen Ib.

Moisture evaporated = Wet Weight − Weight after Drying
= 116.7 − 91.5 = 25.2 gm. = 0.0555 lbs.

$$\text{Initial Water Content} = \frac{\text{Wet Weight}}{\text{Dry Weight}} = \frac{116.7}{52.3} = 2.23$$

As above in percent = 2.23 − 1 = 123%

$$\text{Final Water Content} = \frac{\text{Weight after Drying}}{\text{Dry Weight}} = \frac{91.5}{52.3} = 1.75$$

As above in percent = 1.75 − 1 = 75%

Btu in city gas = 540 per cubic foot at standard conditions

$$\text{Btu/cu. ft. corrected to test conditions} = 540 \times \frac{520 \times 30.294}{531 \times 30}$$

= 534 Btu/cu. ft.

(where 30.294 is the absolute gas pressure in inches of Hg,

$$4'' \ H_2O = \frac{4}{12 \times 1.133} = 0.294'' \text{ Hg; Total pressure} = 30 + 0.294$$

= 30.294″ Hg)

$$\text{Heat supplied in gas in 20 seconds} = 534 \times \frac{3.8 \times 20}{60} = 678 \text{ Btu}$$

Assuming evaporation at 212° F and atmospheric pressure,
heat used to evaporate 0.0555 lb. of water
= 0.0555[(212 − 44) + 970.3] = 63.0 Btu

(where 970.3 Btu/lb is the latent heat of vaporization of water at 212° F)

$$\text{Relative Efficiency} = \frac{63}{678} = 9.3\%$$

The general conditions including gas and water temperatures; gas rate, pressure, and temperature; water temperature; and relative room humidity were taken at the beginning of each series of runs, in the middle and at the end. The averages of these readings were used for computations.

Test Samples and Discussion of Test Results

The main series of samples was received from Calco Chemical Division and consisted of bleached cotton fabrics of three weights. In order to determine the influence of color on relative drying efficiency, each weight of cloth was divided into three parts one of which was left white and the other two dyed with Park and Tilford Tintex dye, Cardinal Red and Black (see Table II).

Using equation (1) for specimen Ir, and substituting

TABLE II. Particulars of samples used in tests.

Sample		Notation	Size in.	Dry gm.	Weight lbs.	Unit Weight oz./sq.yd.
Twill	White	Iw	12.75 x 23	49.8	0.1100	7.75
	Black	Ib	13 x 22.25	52.3	.1150	8.25
	Red	Ir	13 x 22.25	52.8	.1165	8.25
Print Cloth	White	IIw	13.13 x 23	21.9	.0483	3.32
	Black	IIb	13 x 22	21.6	.0476	3.45
	Red	IIr	13 x 22	21.7	.0480	3.48
Muslin	White	IIIw	13 x 23	14.6	.0322	2.22
	Black	IIIb	13 x 22.25	16.6	.0366	2.62
	Red	IIIr	12.5 x 22.5	15.6	.0344	2.56
Jute Natural (Burlap)			13.4 x 26	62.1	.137	8.16
Cotton Khaki (Duck)			13.4 x 23.25	54.5	.120	8.00
Worsted Dark Plaid			12.5 x 24.5	53.5	.118	7.98

the results of one of the runs, the following relationship is obtained:

$$\ln \frac{113.1 - 52.8}{92.9 - 52.8} = k \times 10$$

$$\ln 1.5 = 10k$$

Similarly computed values for other runs of this series and some of the other tests involving at least four runs are plotted on semi-logarithmic paper in Fig. 3.

An examination of the curves with reference to the theory, indicates that:

1. The drying time is directly proportional to the natural logarithm of the ratio of the initial and final moisture content.
2. The drying time is directly proportional to the thickness of the fabric. This is evident from a comparison of curves for the thinner specimens of type I (cotton twill) with those for thicker jute and cotton duck. The former curves have a steeper slope than the latter.

The fact that three curves of Fig. 3 uniformly slope up as the time of drying was increased conforms with the

theory of Fig. 1. Actually more moisture was evaporated at longer drying time than the drying equation indicates. It appears that the change of slope corresponds to the critical point where drying by diffusion began. This reasoning is borne out by the curve for jute, for which material the final percent moisture content was higher than for the others. This fact indicates that the critical point for jute fabric has not been reached.

Effect of Cloth Color

TABLE III. Effect of color. Averages of relative efficiencies in percent.

	I 6″ from burner	I 4″ from burner	II 6″ from burner	II 4″ from burner	III
Black.....	7.59	13.80	7.62	13.10	The results for specimen III are not included because of insufficient number of runs.
Red.....	8.88	13.70	7.70	15.80	
White.....	8.20	14.65	8.50	16.65	

An inspection of Table III reveals that no consistent influence of color can be observed. Black, which ought to have higher absorptivity of infra-red radiation, showed consistently poorer results than white.

Influence of Cloth Weight and Distance from Burner

TABLE IV. Influence of cloth weight and distance from burner. Average relative efficiencies expressed in percent.

Specimen	Percent Weight	Distance from Burner	
		6″	4″
I.....	100	8.20	13.84
II.....	42.4	7.95	13.54
III.....	30.6	13.36	15.50

Table IV brings out two apparent facts: 1. The weight of fabric is of less importance in efficient drying than the character of weave. Note that the relative drying efficiencies of specimens I and II were practically the same. Specimen III, however, was of a more open weave and its efficiency of drying was significantly higher. 2. Distance from the burner hot zone is important. A re-

duction of distance by 33 percent resulted in raising the relative drying efficiency by 45 percent on the average.

Influence of Fabric Material and Structure

In view of varying fabric structures the test results do not suggest any conclusions as to the influence of the raw material of which the specimens were made. The relative efficiencies of the drying of cotton duck follow weight and a close structure. The results for worsted were inconclusive because of singeing at the close distance from the burner used in the tests.

Influence of Other Variables

A consistency of results was shown by the tests. In general, it seems logical to have the penetrating radiant rays, reflected from the burner's parabolic surface, strike the fabric first and thus to pre-heat it gently. Subsequent evaporation heat may be then supplied beneficially by the hot combustion gases surging up from along the refractory walls.

An attempt at drying each side during a separate run did not show any significant benefit as compared with a single run of the same duration.

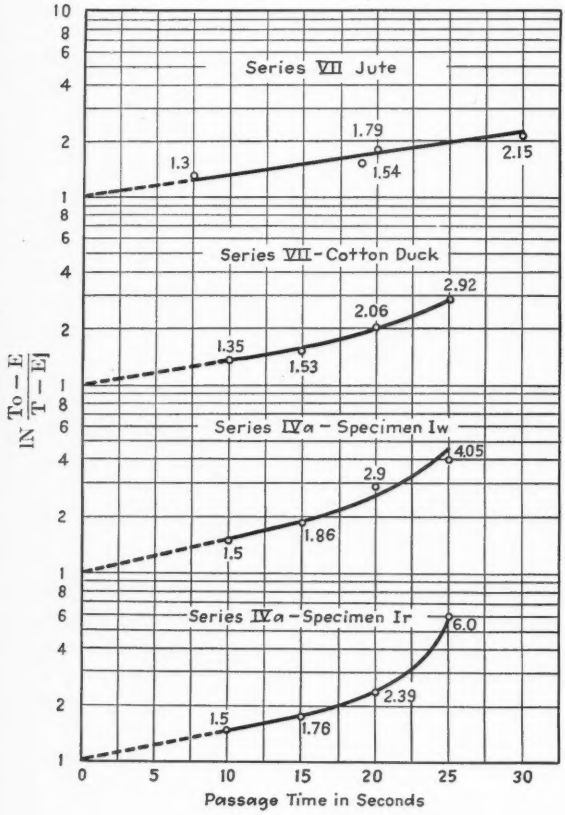


Fig. 3. Test runs plotted using drying equation (1).

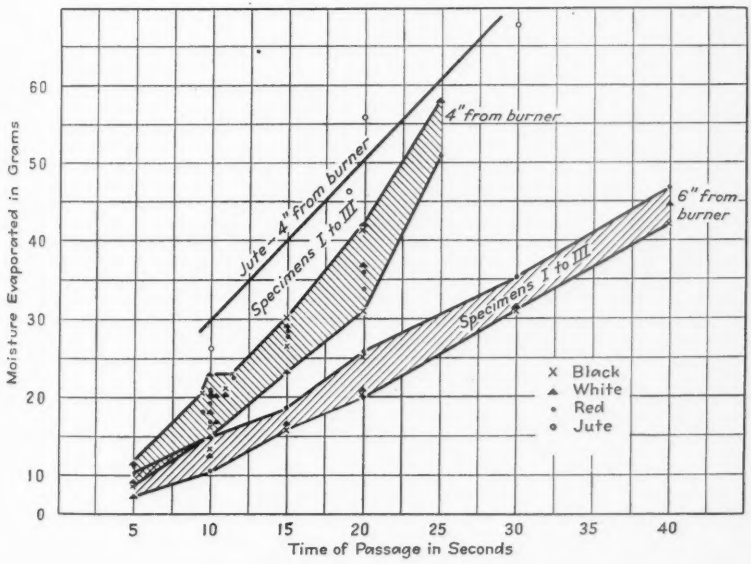
Summary

The test results ought to be treated as qualitative rather than quantitative. By no means should the efficiencies be interpreted as indicative of industrial possibilities. In industrial applications the conditions would be different, and the provision of a continuous sheet of fabric alone would result in a considerably higher efficiency. During the tests it was inevitable that a large amount of heat, which could have been used for drying, leaked past the sample and lowered the efficiency.

In addition the tests were run with a very high initial water content and a somewhat high final moisture content was left in the samples. This course was made necessary in order to avoid any danger of burning the fabrics. It may be added in favor of this procedure that the present application of infra-red heat generators is confined in most cases to evaporating the initial moisture leaving the final and more controllable drying to some type of orthodox drier.

Fig. 4 attempts to bring out the test results in a

Fig. 4. Test results plotted. Intervening areas between outlying points are shaded.



condensed form. The results are comparable on the basis of moisture evaporated since the area of all specimens was about the same (2 sq. ft.). It may be mentioned here that the readings of maximum refractory temperatures ranged between 1600 degrees F. and 1500 degrees F. during all tests. Fig. 4 brings out the same conclusions as shown by Tables III and IV, in regard to the influence of color, nearness of fabric to burner, and effect of weave.

In view of the above conclusions the author infers that the infra-red ray gas generators of the type tested depend for their drying properties mostly on convected heat. To prove this point conclusively, further tests are necessary. Whichever way the heat is derived, however, the fact remains that these generators provide a compact and useful method of drying, which has definite merits when judiciously applied.

Suggestions for Future Research

In order to be strictly applicable, tests of the type described should be performed on actual industrial equipment or on corresponding equipment reduced to a size which would be compatible with laboratory conditions.

The following suggestions are made:

All tests should be made using gas-fired equipment alternately with electric lamps of the same energy input capacities.

A continuous sheet of fabric ought to be used.

An attempt should be made at separating radiant heat from convected heat. This could be done by interplacing glass barriers between the generator and the fabric. Koller [3] states that ordinary window glass ⅛ inch thick absorbs only about 4 per cent of heat radiation.

Determination of temperature at target surface.

In the way of fundamental research it might be of considerable value to find out what wave band would be most suitable for these devices. Since the electric lamp possibilities seem to be well taken care of, various refractories could be tested in gas burners to find the most efficient generating surface.

[3] Koller, L. R., Infra-Red Production and Transmission Reflection and Measurement, *General Electric Review* **44**, 167–73 (March, 1941).

ABSTRACTS

Members of Textile Research Institute, Inc., desiring complete copies of articles abstracted may obtain photostat copies at cost by addressing the Institute's office, 10 East 40th St., New York 16, N. Y. The price of a photostat negative is seldom more than 50 cents per page of original text.

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ANALYSIS: TESTING: LABORATORY METHODS

Fiber-Length Determination

Cotton fiber-length determination using the fibrograph. K. L. Hertel. *ASTM Bull.* **117**, 25–7 (Aug. 1942).

The fibrograph is an optical instrument employing photovoltaic cells for scanning samples of parallel fibers and simultaneously tracing a length-frequency curve. The geometrical properties of the resulting curve, or fibrogram, make it possible quickly to obtain av. lengths of various kinds, variance, coefficients of variation, and other statistical measurements. The time for a complete length analysis is 6 to 7 min. The waviness and taper of the fibers are factors that make the fibers appear too short. The upper-half mean length, however, agrees closely with the staple length. Fibers shorter than ¼ in. are disregarded.

Absorbency Determination

A comparison of methods for the determination of water absorbency by terry towels. V. B. Holland. *Am. Dyestuff Reptr.*, **32**, 167–70 (Apr. 12, 1943).

Both the Wick-up and Larose Methods may serve as standard procedure for measuring the water absorbent qualities of terry towels. The Wick-up is somewhat simpler and faster due to less manipulation, but the Larose Method has an advantage in that it applies pressure in simulating ordinary usage. In order that consistent results be obtained, both should be carried out under standard conditions and a fair degree of skill. The Drop-Square Method is not suitable for a standard procedure since its units of measurement is limited, varying wts. in towels would make it difficult to set up a standard for all towels, entrapped air would introduce further errors, and no 2 squares are dropped alike by the same operator. However, this test is admirably suited for comparative routine quick-testing at the mill production line.

Faults in Textiles

Detection of acid or basic substances in damaged fabrics. C. Whitworth and D. W. Poxon. *Nature* **151**, 198–9 (1943) (through *Chem. Abstr.* 1943, **37**, 2586[2]).

Feigl and Da Silva (*C. A.* **36**, 3454[1], 4047[8]) have proposed methods for detecting basic and acid substances present in materials usually considered insol. These methods are applied to faults in textiles. If a soln. of a Ni salt is incompletely pptd. with dimethylglyoxime and filtered, the soln. applied to cotton or wool damaged by alkali causes the damaged fibers to turn pink. A satd. soln. of $AgCrO_4$ in 6*N* NH_4OH ap-

plied to fabrics damaged by acids gives a dark red-brown color. (Variations in results are described.) With colored materials the ppt. is easily visible under the microscope.

Measurement of Refractive Indices of Fibers

A fiber refractometer. K. Freeman and J. M. Preston. *J. Textile Inst.* 34, T19–28 (May, 1943).

An instrument is described for the rapid determination of the refractive index of fibers. A single observation gives the mean refractive index of a large number of fibers. The fiber refractometer uses an immersion method but does not involve observation of the Becke line or the use of a microscope. The method involves the determination of the wavelength at which the fibers and the liquid have the same refractive index. This is found by observation of the wavelength of the light which is not scattered on passing through the immersed fibers. The dispersion curve of the fibers can be obtained by immersing the fibers in a series of liquids the dispersion curves of which intersect the curve of the fibers. Then by plotting the wavelength and refractive index co-ordinates corresponding to the unscattered light in each case, a series of points is obtained which define the dispersion curve of the fibers. The results of the application of the fiber refractometer to determinations of the refractive indices of five regenerated cellulose rayons are given.

Improved Method for Obtaining Titration Curves

Dissociation constants and pH-titration curves at constant ionic strength from electro-metric titrations in cells without liquid junction: titrations of formic acid and acetic acid. Roger G. Bates, Gerda L. Siegel, and S. F. Acree. *J. Research Natl. Bur. Standards* 30, 347–59, R P 1537 (May, 1943).

An improved method for obtaining the titration curves of monobasic acids is outlined. The sample, 0.005 mole of the sodium salt of the weak acid, is dissolved in 100 ml of a 0.05-*m* solution of sodium chloride and titrated electrometrically with an acid-salt mixture in a hydrogen-silver-chloride cell without liquid junction. The acid-salt mixture has the composition; nitric acid, 0.1 *m;* potassium nitrate 0.05 *m;* sodium chloride, 0.05 *m*. The titration therefore is performed in a medium of constant chloride concentration and of practically unchanging ionic strength ($\mu = 0.1$). The calculations of pH values and of dissociation constants from the emf values are outlined. The titration curves and dissociation constants of formic acid and of acetic acid at 25° C were obtained by this method. The pK values (negative logarithms of the dissociation constants) were found to be 3.742 and 4.754, respectively.

CHEMICAL AND PHYSICAL RESEARCH

Color Blindness

Symposium on Color-Blindness, Foreword. D. Nickerson. *J. Opt. Soc. Am.* 33, 293–4 (1943).

A symposium on color-blindness (Part I, background information, Part II, description of current test developments) was arranged by the Inter-Society Color Council for the midwinter meeting of the Optical Society of America. Abstracts of the three papers in Part I follow; papers in Part II will be published.

Facts of Color-Blindness. D. B. Judd. *J. Opt. Soc. Am.* 33, 294–307 (1943).

This paper is an authoritative report of present-day knowledge regarding facts (as opposed to theories) of

color-blindness. The colors seen by a normal observer can in general be duplicated by mixtures of three lights, each light being independently adjustable in amount. Normal vision is classed as trichromatic, and a corollary of trichromatism is that three kinds of discriminations are possible. These may be classified as light-dark, yellow-blue, and red-green. Types of abnormal color vision, or "color-blindness" may be classed as anomalous trichromatism, dichromatism, and monochromatism, and each is just what the words imply. An observer possessing anomalous trichromatic vision requires three lights to produce all the colors he is capable of seeing, but to produce a given color he requires proportions significantly different from those required by the normal. The distinctions he makes are light-dark, yellow-blue, and red-green, but the ability to make one of the chromatic distinctions (usually red-green) is relatively weak. An observer with dichromatic vision requires a mixture of only two lights to produce the colors he experiences; he makes light-dark distinctions and either yellow-blue or red-green, usually the former. An observer with monochromatic vision can match all the colors he sees by varying the brightness of a single light; he makes light-dark discriminations only. Table 1 presents classifications and characteristics of these and several sub-types of color-blindness, with the wavelength of the maximum of the luminosity function, also the wavelength of neutral points in the spectrum for each type. Causes of color-blindness are briefly discussed. A bibliography of 62 items selected from Dr. Judd's unpublished bibliography is included.

Methodology in Test Preparation. F. L. Dimmick. *J. Opt. Soc. Am.* **33**, 308–15 (1943).

Dr. Dimmick, professor of psychology at Hobart College, summarizes the available information on methodology that is applicable to the problem of testing color vision, so that previous and current tests may be evaluated in this respect on an adequate basis. A number of the judgmental situations met in a test of color vision are described in some detail. Size, position, order, adaptation level, number and type of judgments, form of instructions, practice, capacity level are all considered; though they do not exhaust all the problems of psychological methodology, they form a minimum of controls for any test of color vision.

Evolution of Color Vision Tests. E. Murray. *J. Opt. Soc. Am.* **33**, 316–34 (1943).

Tests for color vision deficiencies have evolved following the discovery of unique cases, the launching of new theories, or from the pressure of emergencies or need for information for studying disease or heredity. The 3-color theory of Young-Helmholtz was the basis for the Holmgren type test; the Hering 4-color theory of linked pairs, red-green, yellow-blue, was the forerunner of the Stilling vanishing pattern test. Many other tests have followed which may be classed (1) according to the media employed, whether reflected or transmitted light, (2) as photopic or scotopic, according as the daylight or dark-adapted eye is used, (3) as individual or group, (4) by scoring method, whether qualitative or quantitative, (5) by response, whether simple or complex mental operations are required, or motor or verbal responses stressed. All well-known and many less well-known tests are mentioned, and evaluated. A 52 item bibliography refers to much of the original literature on the tests discussed and the theories involved.

Vinyl Ethers of Cellulose

Vinyl ethers of cellulose. A. E. Favorskii, V. I. Ivanov and Z. I. Kuznetsova. *Compt. rend. acad. sci. U.R.S.S.* **32**, 630–2 (1941) (in English). (Through *Chem. Abstr.*, 1943, **37**, 2172[9]).

Cotton linters treated with NaOH and NaClO had a degree of polymerization of 800–1000. This alkali cellulose was then treated with acetylene (**I**) in the presence of a catalyst in an autoclave at 120–50° for 4 to 48 hrs. with the expectation of obtaining mono-, di- and trivinyl ethers of cellulose by addn. of 1, 2 or 3 moles of **I** to cellulose. Detn. of C and H in the product purified by washing with EtOH and H_2O gave 49.1–58.3% C and 6.2–6.6% H, compared with 43.8–44.1% C and 5.3% H for control samples having the same treatment except **I**; this indicates that mostly di- and some trivinyl ethers of cellulose were formed. Controls dissolved completely in Schweitzer reagent but **I**-treated material dissolved only partly. Acid hydrolysis of the products gave unchanged cellulose (44.5% C and 6.4% H and sol. in Schweitzer reagent) and acetaldehyde (quantitatively with Na nitroprussiate). The cellulose derivs. formed were partially sol. in dioxane, di(chloroethyl) oxide, chloroglycol and ethyl acetate. Pptd. from chloroglycol the C and H contents correspond with those for the monovinyl ether of cellulose.

The Cellulose Molecule

Physical chemistry of the cellulose molecule. The Svedberg. *Svensk Papperstidn.* **45**, 444–58 (1942) (German and English summaries) (through *Chem. Abstr.* 1943, **37**, 2570[3]).

S. reviews various methods for detg. the mol. wt. of cellulose—namely, the x-ray analysis for cellulose in the solid state and ultracentrifugal, diffusion and streaming double-refraction methods for the liquid state. The results are identical within the limits of exptl. errors. The values of the mol. wt. of cellulose decrease in the order: cotton, wood meal, tech. wood cellulose. The polydispersity can be estd. by measurements of the spreading of the sedimentation max. and by observation of anomalous conditions of diffusion and streaming double refraction. Cotton cellulose is less polydisperse than tech. wood cellulose.

Oxidized Cellulose

Oxidized Cellulose. Cornelius C. Unruh. *Synthetic Organic Chemicals*, Eastman Kodak Co. **15**, No. 1 (1943).

A brief resume of the effect of oxidizing agents upon cellulose (particularly cotton). The structure of oxidized celluloses is discussed.

Structure of Cellulose

Carbohydrates. XIII. The supermolecular constitution of cellulose. XIV. The supermolecular reactivity of cellulose. XV. The supermolecular reactivity of cellulose. Th. Lieser and Franz Fichtner. *Ann.* **548**, 195–225 (1941); cf. *C. A.* **33**, 5648[6]; **36**, 4329[7] (abridged) (through *Chem. Abstr.* 1943, **37**, 2567[4]).

Consideration is given to the question whether the cellulose macromol. is always the reacting entity of cellulose or whether the submicroscopic or the supermol. entity can enter into reaction. This entity, the cellulose micelle, consists of long principal-valence chains united into crystallites which are firmly united through assoen. or mol. cohesion. The micellar power can be overcome by exceeding a definite concn. of an active agent. The authors have investigated the reactions of cellulose in the solid fibrous state.

Nitration of Cellulose

Special kind of raw materials for nitration. Theoretical considerations on nitration of cellulose. Karl Fabel. *Nitrocellulose* **12**, 103–8 (1941); *Chem. Zentr.* **1942, I,** 143; cf. *C. A.* **36**, 5344[2] (through *Chem. Abstr.*, 1943, **37**, 2928[8]).

A review of the nitration of cellulose from various kinds of wood, straw, grasses, bamboo, grape vine, textile fibers, bagasse, corn stalks, fruit and nut refuse. Different properties of nitrocellulose obtained are largely attributed to cellulose depolymerization and high pentosan content. Data are given on yields, acid consumption, viscosity, clarity of film, soly. and form in which the material is nitrated. In both propellant and lacquer fields, cellulose of sufficient degree of purity gives nitrocellulose equal to that obtained from linters.

Sorption of Basic Dyes

The sorption of basic dyes by cellulose. D. Krüger. *Melliand Textilber.* **22**, 428–31 (1941); *Chem. Zentr.* 1942, **I**, 269; cf. *C. A.*, **36**, 5641[3] (through *Chem. Abstr.*, 1943, **37**, 2579[10]).

Comparison of the absorption spectra of basic dyes in aq. soln. and dyed onto cellulose films shows that the absorption maxima in the dyed films are shifted toward the longer wave lengths. Significant differences in the shapes of the absorption curves are also noted. It is concluded that the dye exists in the cellulose film as a polymeric rather than as a simple ion. The no. of previously existing free acid groups in the cellulose is a likely measure of the quantity of basic dye which will be taken up in such a manner as to be reasonably wash-fast. The size of the intermicellar spaces is of importance in affecting the velocity of sorption and desorption.

Diastase Activity

Effect of inorganic compounds on the activity of malt diastase. A. E. Braun. *J. Biol. Chem.*, 1942, **145**, 197–199 (through *J. Soc. Dyers and Colourists* **59**, 80 (Apr. 1943).

The effect of some inorg. plant nutrients on diastase activity depends both on their nature and on their conen. Under the conditions used, $MnCl_2$ with an ionic strength < 0.3 and $ZnCl_2$ with an ionic strength < 0.0003 increased the activity, whereas iron chloride, copper chloride, and boric acid did not increase the activity in any conen. and even depressed it. The results indicate that the metallic ion strongly influences diastase activity whereas the chloride ion has little effect.

DYEING: BLEACHING: FINISHING

Application of Pigments

The application of water dispersed pigment colors to textiles. Fred G. LaPiana. *Am. Dyestuff Reptr.* **32**, 261–4 (June 7, 1943). Paper presented at meeting Rhode Island Section, A.A.T.C.C., April, 1943.

The application of the usual binders or film forming substances, and the vehicles are described. Recently a new class of materials has been developed: the water soluble and water dispersible synthetic resins, which are applied to the cloth and subsequently made water insoluble by curing. Especially important are the protein-urea-formaldehyde complexes which can be rendered water insoluble by precipitation with acid. The latest discovery in this field is that some organic compounds of very high molecular construction, can be made hydrophobic and water resistant by chemically blocking the OH or hydroxyl groups through which they

absorb water. The general discussion which followed presentation of the paper is included.

Infra-Red Reflecting Pigments

Infrared reflecting and fluorescent pigments on textiles for the armed forces. R. Kenneth Jackson. *Am. Dyestuff Reptr.* **32**, 259–60 (June 7, 1943).

Recent developments in infrared sensitive photographic plates employing the tetra and penta carbo-cyanine dyes show an effective range up to nearly 1.4 microns wavelength. By masking out wavelengths below 0.7 micron it is possible to photograph details through fog or smoke. These fibers are so sensitive that pictures can be taken in a dark room, using an infrared source of "black body radiation" such as an electric flat-iron. For army applications, such as the camouflaging of gun emplacements when surrounded by foliage, it is necessary to use infrared reflecting pigments because the surrounding foliage is highly reflective to infrared rays. Pigments can be made nonreflecting and highly absorbent to infrared by addition of as little as 1 per cent of black. For determining infrared reflection only a simple apparatus, which is described, is required. Applications of ultraviolet light and fluorescence are briefly described.

Dyeing Rayon

Rayon dyeing. P. M. Joshi. *Indian Textile J.* **21**, 21–4 (1942) (through *Chem. Abstr.* 1943, **37**, 2581[4]).

Among difficulties encountered in the dyeing of vat colors on viscose hanks are: (1) unlevel dyeing, (2) chem. damage due to the action of alkali used in dyeing of vat colors, (3) mech. damage such as entanglement and breaking of threads and (4) loss of lustre. Each is discussed briefly, also naphthols on viscose hanks, animalized viscose and dyeing of acetate rayon.

Dyeing Acetate Rayon

The pretreatment of acetate rayon. J. Hense. *Deut. Färber-Ztg.* **77**, 397 (1941); *Chem. Zentr.* **1942, I**, 540 (through *Chem. Abstr.* 1943, **37**, 2585[4]).

Before a piece is dyed it should be checked for spots which can be damaged by later improper ironing. Instead of placing the goods in Na_2CO_3 or NH_4OH baths before the dyeing, immersing them in an enzyme bath is recommended. The rayon is first washed in a bath to which an alcohol sulfonate has been added and then treated with a bath contg. an alcohol sulfonate, HCOOH and Na_2SO_4. Instead of stripping with Burmol or Cl (as, e.g., in the case of a red garment which is to be dyed green), treating with a green semi-wool dyeing bath is recommended. Under this treatment acetate rayon assumes a yellowish tint which can very readily be redyed green. Any mixed fiber present can easily be stripped.

Emulsions for Dyed Rayon

Treatment of dyed rayon with emulsions. A. F. Lomanovich and S. G. Koltypin. *Legkaya Prom.* **19**, No. 8, 42–3 (1940); *Chem. Zentr.* **1941, I**, 1625 (through *Chem. Abstr.* 1943, **37**, 2939[7]).

A paraffin emulsion for the treatment of dyed rayon is prepd. as follows: To a fused mixt. of 10 parts paraffin, 10 parts stearin and 6 parts colophony is added a soln. of 2 parts NaOH of 40° Be. and 6 parts 25% NH_3 dild. 1:2.5 with water. The mixt. is then heated to 80° and water is added to make 100 parts. The emulsion prepd. in this manner is stable indefinitely and does not sep. even when greatly dild. with water (1:100). The dild. emulsion shows

the first signs of breaking down only after 8 days. In tests in actual operation the emulsion was dild. 1:50 or 1:60 with warm water (50°) with the addn. of 1 cc. of 25% NH_3 per 1. To stabilize the dild. emulsion, 0.75–1 g. of soda and 1–1.5 g. olein soap were added per 1. In prepg. the bath for the treatment of the dyed silk the water is heated to 50–60° and 1 g. of soda and 1.5 g. olein soap are added per 1. of water. The Ca soap formed is skimmed off from the surface of the water and sufficient paraffin emulsion is added to give a paraffin concn. of 2–3 g. 1. The dyed silk is introduced into the bath contg. the emulsion directly from the dye bath without previous washing. It is agitated in the emulsion bath 5 min. and then pressed and dried on a centrifuge. Plant tests showed that the use of the emulsion treatment greatly increased the output of the rinsing machine, the av. increase in capacity being 63% for weft and 154% for warp. The strength of the silk was increased 8–9%.

Dyeing and Finishing Army Fabrics

Treating army lightweight protective covering materials. Allison Fitzgerald. *Textile Bulletin* **64, Part I,** 20–2, 50–2 (April 15, 1943); **64, Part II,** 14–6, 40–1 (May 1, 1943); **64, Part III,** 18–20 66 (May 15, 1943); **64, Part IV,** 16–8, 38–9 (June 1, 1943); **64, Part V,** 26, 46–7 (June 15, 1943); **64, Part VI,** 14B, 34–7 (July 1, 1943).

The processing, dyeing and finishing of cotton, aralac, acetate and viscose rayon fabrics of importance for military and civilian uses are treated in a series of articles. Technical recommendations on the basis of best plant procedure are given for desizing, boiling-off, scouring, temperature control, acid and alkali resistant agent treatment, application of new types of coloring agents and cellulosic carriers, and special finishes required to meet the many new military and civilian specifications. **Part I** describes the P.Q.D. specifications for army lightweight covering under three general groups: comforters, netting, and mosquito bars. Four methods for evaluating color fastness are detailed: the one and the two bath aftertreatments, the padding of comforter cloth, and continuous piece dyeing. **Part II** explains two procedures for the dyeing and finishing of 1.8 ounce cotton insect netting. **Part III** is devoted to a third procedure, which includes 3 formulas for dyeing netting made of cotton prepared under procedure number one, and which gives it a resin finish that will meet the Quartermaster Corps specifications as to weathering, water repellency, mildew resistance and cold water fastness. **Part IV** deals with military fabrics possessing potential value for civilian uses. Leatherneck twill made of viscose rayon and combed cotton is one of the most suitable outerwear fabrics now being processed. Its preparation for meeting military and civilian specifications is described under two procedures, including particulars on the desizing and boiling-off operations, dyeing, and padding of vat color. **Part V** covers the dyeing of spun rayon and aralac piece goods. Two practical plant preparation and dyeing procedures using selected direct colors are given. These processing methods are outlined as carried out on the padder and dyebeck, the first run on both, the second on dyebeck only. **Part VI** takes up various other groups of dyestuffs, direct and neutral wool dyeing and special types of acic and wool dyeing colors that possess special value for processing aralac. Practical notes as to preparing the dyebath for handling the colors are stressed, together with suggestions

on tinting agents for aralac and the best methods for removing them prior to bleaching and dyeing. A brief description is given of the scouring, bleaching and finishing of spun rayon and aralac by means which results in finished goods possessing a desirable hand and freedom from dustiness.

FIBERS: YARNS: FABRICS: MECHANICAL PROCESSES

Long-Staple Cottons

Comparative manufacturing performance and fiber properties of certain long-staple cottons. Food Distribution Administration, War Food Administration. Multilithed report, July, 1942. 6 pp.

Fiber and spinning test data are presented and discussed for several samples of Wilds 13 and S x P; for the Egyptian cottons Giza 7, Karnak, Maarad, Malaki, and Sakha 4; for two Sudan cottons designated as Sudan L and Sudan S; and for two Peruvian cottons, Pima and Tanguis. The outstanding variety in the test is a new American-Egyptian cross called S P x Sak 35, which was greatly superior in yarn strength to any of the Egyptian samples tested. This variety is still in the experimental stage. The Wilds 13, a rapidly increasing American upland variety, is approximately equal in spinning quality to the Giza 7, which comprises about two-thirds of the Egyptian and Anglo-Egyptian Sudan cotton consumed in the United States. Giza 7 is somewhat less neppy, however.

Electrical Properties of Fibers

The electrical properties of fibers. J. W. Illingworth. *Text. Recorder* **60**, 42–6 (March 1943); **60**, 36–9 (April 1943); **60**, 39–43 (Feb. 1943).

Textile fibers have great adaptability and strength, combined with flexibility and a certain amt. of insulating power. These properties together with a relatively low cost and general availability are responsible for their comparatively important place in the elec. industry. Apart from practical considerations, a study of the variation of elec. resistance of fibers with moisture content gives us a neat method of measuring the moisture content and much valuable information concerning the structure of the fibers. The problem of "static" is intimately bound up with the conductivity of the fibers. The comparatively high elec. resistance of many textile fibers, so desirable in the manuf. of elec. app., is one of the chief causes of the static effects so frequently noticed in processing fibers and, sometimes also, in the finished articles. In the prevention of the accumulation of charge on the fibers and the machinery, a good earthing system plays an important part. New synthetic fibers are now being made—Nylon, Vinyon, Cordura, Aralac and others. This fact, together with a tendency to increase machine speeds, probably accounts for the increased static troubles which have been experienced in recent years.

Electrical Properties of Fibers

The electrical properties of fibers, III. J. W. Illingworth. *Textile Recorder* **60**, 46–50 (May, 1943).

Wool and human hair possess a directional tribo-electric effect. A fiber rubbed against another fiber acquires a charge the sign of which depends on the direction of rubbing. If a number of wool fibers lie parallel with root ends together, then a fiber pulled out by the tip acquires a negative charge. When a fiber lies in the opposite direction to its fellows no charge is produced whether it is pulled out by the root or the tip. Wool and hair appear to be unique in showing a reversal of charge with

reversal of the direction of rubbing. Wool is also piezo-electric, that is it can acquire an electric charge when subjected to pressure. This is demonstrated by an experiment which is described. Wool is also pyro-electric, that is it develops an electric charge on subjecting to a change of temperature. Certain manufacturing processes take advantage of the ease with which most fibers acquire and retain electrostatic charges. Brief references are given to the findings of a few investigators. Effect of ionization of the atmosphere is discussed.

Artificial Fibers

Fibers of high strength and their applicability. A. Zart. *Die Chemie* **55**, 11–3 (1942) (through *Chem. Abstr.* 1943, **37**, 2583[4]).

A general discussion of the properties of artificial fibers, in particular of cellulose wool (duraflox), and a comparison with natural cotton shows that in spite of recent progress in the mech. properties, they are still inferior to cotton as regards strength in wet condition, twisting strength, fatigue bending no. and swelling capability. For wearing apparel, the handle of the material does not remain after washing as in cotton. Subsequent treatment of the fiber with formaldehyde or impregnation with urea or formaldehyde does not give permanent improvement.

Elasticity of Rayon Yarns

Elasticity, creep and recovery of acetate and viscose rayon yarns. H. Mark and J. Press. *Rayon Textile Monthly* **24**, 57–9 (June, 1943).

Elasticity, flow and relaxation of acetate and viscose rayon were measured. The stresses ranged from 0.1 to 2.5 grams per denier, and were applied for periods of 10^{-2} to 10^{6} seconds. An attempt is made to give a quantitative description and a molecular interpretation of flow and relaxation curves on the following basis: The investigated materials, being built up of disordered (amorphous) and ordered (crystalline) areas which exhibit specific elastic and viscous properties, can be characterized by a modulus spectrum and a relaxation spectrum. The logarithmic part of most flow curves may be explained by assuming both the occurrence of intermolecular reinforcement through crystallization and the existence of a continuous multitude of delayed elastic elements.

Properties of Nylon Yarn

Nylon yarn and its possibilities. G. Loasby. Abstract of lecture before Coventry Textile Society. [Through *Silk Journal & Rayon World* **29**, 32–6 (May, 1943)].

Nylon yarn has a high wet tenacity which is higher than its knot tenacity. Strengths of 14 different knots are given showing a variation in strength of from 75 to 97 per cent as a per cent of dry tenacity. Successful knots for nylon must be small, they must lie flat, and they must not slip. Thermal properties, moisture affinity, refractive index, electrical properties and resistance to degradation are described. Extensibility and recovery from strain are illustrated by stress-strain graphs. Acetate rayon dyestuffs of dispersed and soluble dyes are easy to apply and are reasonably fast. They are the best level dyeing colors for nylon.

Properties of Nylon

Nylon. E. V. Garner. *Silk Journal & Rayon World* **29**, 18–20 (March, 1943).

This article describes the manufacture of 66 nylon, the most important of the large family of polyamides designated by the term Nylon. The textile fibers obtained by extrusion of the molten material are character-

ized by high tensile strength, excellent elastic recovery, resistance to moisture, chemical stability and lustre. The relation of these properties to the chemical and physical structure is discussed with special reference to the use of X-ray methods in studying crystal structure, size and orientation, and degree of crystallinity. The problem of the strength of textile fibers is a very complex one depending on a number of factors, firstly on the molecular length, and then on the percentage of crystalline material, crystal size, and degree of orientation of the crystals in the fiber, and finally on the specific arrangement of molecules in the crystal. Nylon is a particularly suitable material for the study of these factors since not only is its chemical constitution known with certainty, but it also can be obtained in a chemically pure state. Furthermore, by suitable treatment the degree and character of the crystallization can be varied and the corresponding changes in strength and elasticity observed.

Military Fabrics

Manual of military fabrics, IV—8.2 oz. Cotton Twill, **Type II.** *Textile World* **93,** 82–3 (May, 1943). V–8.5 oz. Herringbone Twill. *Ibid.* 93, 94–5 (June, 1943).

The Philadelphia Quartermaster Depot requires large quantities of 8.2 oz. cotton twill in five types. These fabrics are covered in Army Specification No. 6–201 B issued Dec. 9, 1942, which supersedes Army Specification No. 6–201 A, 6 S–201 A, and 6–237. Part IV gives a brief abstract of that part of Specification No. 6–201 B, which relates to Type II twill, followed by detailed information—not given in the specification—on the manufacture and processing of this fabric. Also are required large quantities of 8.5 oz. herringbone twill covered in Army Specification No. 621 and Amendment No. 1. Part V of the series covers Specification No. 621, and gives detailed information in regard to manufacture and processing of this fabric.

Mildewproofed Cotton Fabrics

Mildewproofed cotton fabrics. Lt. Joseph E. Goodavage. *Am. Dyestuff Reptr.* **32,** 265–70 (June 7, 1943); *Textile World* **93,** 92–3 (June, 1943).

Structure and development of molds responsible for the "mildew" found on cotton fabrics are described. The fungicides now being applied on cotton materials to meet the mildewing requirements of the Philadelphia Quartermaster Depot are listed. Methods for application of various fungicides are discussed, giving advantages and disadvantages of each method. Performance tests are described to which materials required by the Philadelphia Quartermaster Depot are subjected.

Reclaiming Fiber from Card Strips

Cotton card flat strips. E. H. Helliwell. *Textile Age* **7,** 46–52 (June, 1943).

Analyses show that flat strips contain approx. 70 per cent of usable fiber. Surgical gauze and tobacco cloth mills have reworked flat strips directly on the card. Adjustments involve placing the flat comb at back of card, dispersing with the Thompson roll and permitting the strips from comb to fall evenly on ingoing lap. Results of a test are given which compares cards running on regular stock with those using reworked strips. Estimate of money savings are shown. An increase in licker-in and fly waste partially offsets the saving. Little difference was noted in other types of waste. A comparison in quality is also tabulated.

MISCELLANEOUS

Clay for Sizing

Examination of china clay for sizing. S. M. Nanal. *Indian Textile J.* **53**, 13–4 (1942) (through *Chem. Abstr.* 1943, **37**, 2586[8]).

A crude method of estg. chalk consists of titrating 0.5 g. of the clay and a like quantity of dry chalk separately in hot water against a soln. of H_2SO_4 contg. 10 cc. per l. China clay has less covering power than chalk. China clay feels greasy and smooth when rubbed between thumb and finger with force. The absorptive capacity of clay for water is ascertained as follows: Take 10 g. of clay and paste it well with cold water, transfer to a 100-cc. cylinder, making up to the 100-cc. mark with water. Shake the cylinder and let stand 24 hrs. and read the vol. of "settled clay." Another indication of the fineness of the clay is to take 5.0 g. of clay and paste well with water and transfer to a 100-cc. cylinder and make to the 100-cc. mark with water. Shake well and allow to stand. After 10 min. read the vol. of settling clay, let stand another 10 min. and read again. A good clay will settle with a clear level.

Carbonizing Piece Goods

The theory and practice of carbonization. W. Haussner. *Melliand Textilber.* **22**, 590–2, 637–40 (1941); *Chem. Zentr.* **1942, I**, 951 (through *Chem. Abstr.* 1943, **37**, 2586[5]).

From observations on the carbonizing of piece goods in the raw state, prewashed before fulling, after fulling and after dyeing, it is concluded that weaker acid (H_2SO_4) at a higher temp. is better for the wool than stronger acid at a lower temp. Carbonizing with $NaHSO_4$ gives the best strength test values. Data and information are given on treatment effect of neutralizing with Na_2CO_3 or NH_4OH on the tear resistance and stretch of ladies' suit and dress materials is discussed.

Carding and Spinning

Carding-spinning discussion by mail held by Georgia group. Anon. *Cotton* **107**, 91–6 (June, 1943).

Practical problems of carding and spinning were discussed by mail, 20 Georgia mills submitting answers to questions. Higher card speeds and lap weight were among the questions discussed in relation to carding. Effect of overhead cleaners on ring life, straightening spindles, synthetic long draft aprons and prevention of slubs in piecing-in on long draft spinning were included among the questions on spinning.

Cleaning Textiles

Preliminary cleaning (of textiles) with fat-saving washing agents. W. Pflumm. *Spinner u. Weber* **59**, 8–9 (1941); *Chem. Zentr.* **1942, I**, 285 (through *Chem. Abstr.* 1943, **37**, 2587[2]).

Aliphatic alcohol sulfonates, e.g., the Gardinols, are recommended and their use is in accordance with German official regulations. The chem. nature, applications and advantages of the Gardinols are discussed. The combination of alcohol sulfonates with fat solvents for the cleaning of highly soiled textiles is described. Lanaclarin is an example of such powerful washing agents.

Dermatitis from Synthetic Finishes

Dermatitis from new synthetic resin fabric finishes. Louis Schwartz. *J. of Investigative Dermatology* **4** (Dec. 1941). (Through *Rayon Textile Monthly* **24**, 69, June, 1943).

A severe outbreak of dermatitis among the population of the United States and Canada was traced to a

particular synthetic finish used for such fabrics as underwear, pajamas, house dresses and stockings. The finish contained an acid ester gum which was the actual irritant. The eruption did not appear until a period of five days or more had elapsed after the fabrics were worn. The manufacturer of fabric finishes should test new finishes for their skin irritating properties by means of the patch test which is described.

Postwar Employment in Textiles

Postwar textile manpower plans. A. Wyn Williams. *Textile World* **93**, 82–3 (June, 1943).

The basic problem in all countries is the re-employment of manpower in peacetime jobs, with reasonable assurance of both security and opportunity. Unless that problem is solved no other problem is solvable. Any industry which, before the war, did not give its workers promise of financial security and prospects for the future failed to attract into its working forces youthful new recruits. That this results in inability to deliver the goods when maximum effort is required is proved by the wartime experience of Great Britain. In that country, for example, cotton textiles has become an old people's industry, with an average age of machine operators at 48. The implications of this trend are such that the British Cotton Industry are adopting corrective measures. Conditions in the British Textile Industry are described and also measures being taken for solution of the problem.

Wool as a Reducing Agent

Reducing properties of sheep wool. Leo Kollmann. *Melliand Textilber.* **22**, 478–82 (1941); *Chem. Zentr.* **1942, I**, 290 (through *Chem. Abstr.* 1943, **37**, 2584[4]).

Clean wool invariably exhibits reducing properties due to NH_2 groups from the degradation products of keratin. The reducing power is proportional to the surface area of the fibers and is greater in wool which has suffered previous mech. damage. It is detd. by titration with $KMnO_4$ in acid, alk. or neutral soln., the highest readings being obtained by acid titration. During processing the reducing power may be increased or decreased. Increases are obtained where deep-seated alteration of the keratin takes place, particularly from exposure to alkalies. pH 12 at room temp. or pH 11 at 45° causes an increased reducing power. Prolonged dyeing time injures "reducing" wool more than wool whose reducing power has been neutralized by CH_2O pretreatment. In chrome dyeing by the afterchrome process no significant difference is noted between reducing wool and undamaged wool. Prechrome dyeings are stronger on reducing wool. Reducing wool which has been penetrated with CH_2O behaves like undamaged wool in prechrome dyeing.

Degreasing of Wool

Extraction of wool with dichloroethane. A. I. Matotskii, I. A. Rapoport, E. I. Garlinskaya and G. D. Tarnovskaya. *Sherstyanoe Delo* **19**, No. 3–4, 14 (1940); *Chimie & Industrie* **44**, 432 (1940) (through *Chem. Abstr.* 1943, **37**, 2583[8]).

By extn. with $C_2H_4Cl_2$ wool can be degreased without deterioration. To remove the last traces of solvent it is merely necessary to place the degreased wool under vacuum and blow hot air or steam through it. To preserve the quality of the extd. grease, the solvent should also be removed under reduced pressure. Wool degreased in this manner does not require as thorough washing as that degreased in the usual manner.